# INDEX

| SR. NO. | TITLE | DATE | TEACHER'S SIGN / REMARK |
|---|---|---|---|

→ Gear manufacturing processes
① form milling ② Roll forming ③ Hobbing
Broaching is not used for gear profiling.

→ Shaving - for dimensional accuracy, squaring and smoothing of edge.

→ Flange micro meter - for finding dia of bore

→ Pitch Of Thread can be measured by screw pitch gauge / pitch measuring machine

→ Mechanism of material removing in chemical milling -
a) Remove it by dissolving it in chemical solution
b) Remove it by ~~[illegible]~~ aberration
c) Remove it by shear
d) Combination of above three

→ Increase in rake angle causes decrease in chip thickness and increase in shear angle

→ Shanks of taper drills are provided standard taper known as sellers taper

→ Slip gauge manufactured by high carbon steel.

→ Metal which freezes last in crystal boundaries contains bulk of impurities which were dissolved in original molten metal, This is called minor segregation

→ Bottle riser method is used when mold is weak & casting modulus > 0.16

→ **Welding**

weld o/p current

$$\boxed{\frac{D_d}{D_r} = \frac{I_r^2}{I_d^2}}$$

current

current

weld o/p current

→ Casting method best suited for high melting point material — investment casting

→ For thermosetting materials, following processes are used — Transfer moulding, injection moulding, extrusion.

→ i) Limit | Permissible variation in size
ii) Fits | Degree of tightness of block with the mating part
iii) Tolerance | Range of permissible variation in the dimension
iv) Allowance | Prescribed difference blocks with the dimensions of mating parts to perform specific functions
v) Deviation | Algebraic difference b/w actual size and corresponding basic size.

→ Extrusion

capacity of press

$$\boxed{\frac{\sigma_x}{\sigma_0} = \ln\left(\frac{A_0}{A_f}\right)}$$

input c/s area

o/p c/s area

average yeild strength

→ Taylors Principle of Limit Gauges
i) GO gauge should incorporate as many dimensions as it is convenient and suitable to gauge in operation
ii) Separate NO GO gauge should be used for each and every dimension

→ Solidification Time $\propto V^2$

→ Auto-collimator — angle measurement

→ Constantan — Ni + Cu

→ Green sand mold indicates that mold contains moisture.

→ Steps in powder metallurgy —
Pulverisation —
1. Atomisation
2. Chemical Reduction
3. Electrolysis
4. Mechanical pulverisation
5. Shotting
6. machining

Processing—

→ Blending - different metal powders.

→ Briquetting / compacting

→ Pre-sintering - heating to below sintering temp. Removes lubricants & binders

→ Sintering - (heat)

→ Secondary processes

i) sizing
ii) coining
iii) machining

give proper dimensioning & toleracing

iv) Infiltration - placing Cu/Brass on top of pre-sintered part and heating it again.

v) Impregnation - put in tank containing lubricant.

vi) Plating - colouring and corrosion protection

vii) Heat Treatment

→ In a gating system $\boxed{1:2:4}$ shows sprue base area : ingate area : casting area.

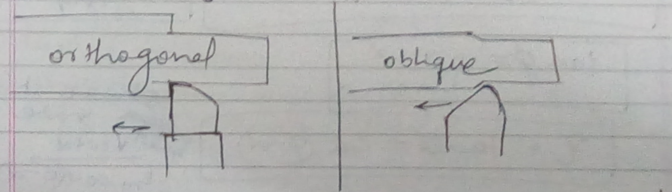
→ Solidification relation

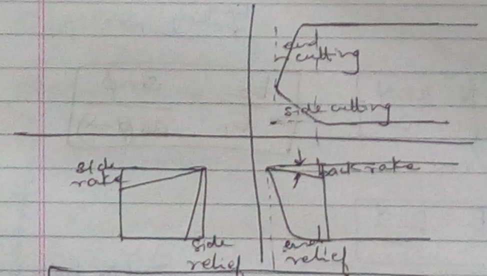
$$\boxed{K = C_1\sqrt{T} + C_2}$$

thickness cooled in time

pressurised gating system 2 : 1.5 : 1

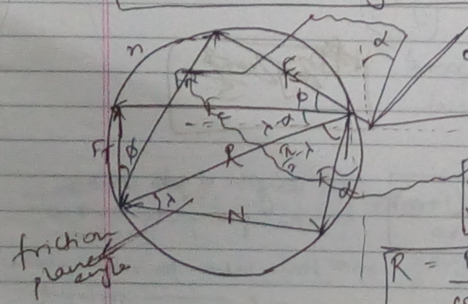
# Machining & Tool Geometry




| | |
|---|---|
| back rake | $\alpha_b$ |
| side rake | $\alpha_s$ |
| side cutting | $\psi_e$ |
| end cutting | $\psi_s$ |
| end relief | $\gamma_e$ |
| side relief | $\gamma_s$ |

$\boxed{\text{orthogonal cutting } \tan\alpha_b \cos\psi_s = \tan\alpha_s \sin\psi_s}$




cutting force = $F_c$  Thrust force = $F_T$

$\boxed{\text{shear } F_s = F_c\cos\phi - F_T\sin\phi}$

$\boxed{\text{normal } F_n = F_c\sin\phi + F_T\cos\phi}$

$\boxed{\text{friction } F = F_c\sin\alpha + F_T\cos\alpha}$

$\boxed{\text{normal } N = F_c\cos\alpha - F_T\sin\alpha}$

$$\boxed{R = \frac{F_s}{\cos(\phi+\lambda-\alpha)}} \qquad \boxed{\mu = \frac{F}{N}}$$

merchant

$$F_c = \frac{\tau w t}{\sin\phi}$$

t → uncut thickness, w → chip width

power = work done = $F_c V$

| merchant | L&S |
|---|---|
| $2\phi + \lambda - \alpha = \frac{\pi}{2}$ | $\phi + \lambda - \alpha = \frac{\pi}{4}$ |

$\boxed{\mu = \tan\lambda}$

$r = \dfrac{\text{chip velocity}}{\text{cutting speed}}$

$r = \text{chip thickness Ratio} = \dfrac{\text{uncut}}{\text{cut}}$

$\dfrac{\text{chip velocity}}{\text{cutting speed}} = \dfrac{\text{depth of cut}}{\text{chip thickness}}$

$$\boxed{\tan\phi = \frac{r\cos\alpha}{1 - r\sin\alpha}}$$

$$\boxed{\gamma = \tan\phi + \cot(\phi - \alpha)}$$

shear strain rate = $\dfrac{V\cos\alpha}{t_m \cos(\phi-\alpha)}$

cutting speed

thk of primary shear zone

## Lathe

1. cutting speed $\boxed{N = \dfrac{\pi D N}{1000}}$

$$\boxed{\frac{t_2}{t_1} = \frac{\sin\phi}{\cos(\phi-\alpha)}}$$

2. Feed = f mm/rev
3. Depth of cut $\boxed{t = \dfrac{D-d}{2}}$
4. machining time = $\boxed{\dfrac{l}{fN}}$ min → for facing as well as turning
5. $\boxed{MRR = \pi D_{avg} f t}$ mm³

## Shaper

1. cutting speed $\boxed{V = \dfrac{LN(1+m)}{1000}}$

L = length of stroke
N = no. of complete strokes per min
m = $\dfrac{\text{time taken for return stroke}}{\text{— " — forward stroke}}$

2. machining time = $\dfrac{w}{f} \times \dfrac{L(1+m)}{1000V} = \boxed{\dfrac{w}{fN}}$ min

w → width of surface; f → feed; V → cutting speed

3. $\boxed{MRR = f\,d\,N\,L(1+m) \ \dfrac{mm^3}{min}}$

## Drill

1. cutting speed $V = \dfrac{\pi D N}{1000}$ m/min
2. Feed = f mm/rev
3. Drill Time

$$\boxed{t = \frac{L}{fN} = \frac{l + 0.3D}{fN}}$$

l = length of job

4. $\boxed{MRR = \dfrac{\pi D^2}{4} \times f \times N}$

~~Machining~~

~~[illegible]~~

Cutting speed for min cost

$$V = \frac{C}{\left[\left(\frac{1}{n}-1\right)\left(t_s + \frac{C_t}{C_m}\right)\right]^n}$$

$VT^n = C$

$t_s$ → time reqd to reset the tool

$C_t$ → cost of tool

$C_m$ → overhead cost during machining

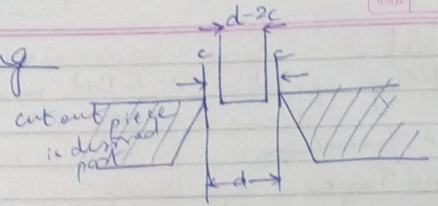
→ Permeability No. = $\dfrac{501.28}{P \times T}$

P → gauge pr

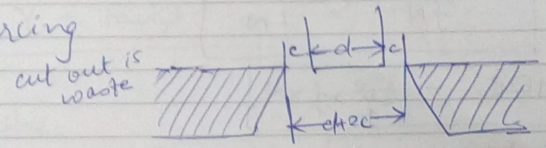
T → time taken for gas to escape.

For gases that escape out of sand mold.

## → Blanking




## Piercing




Q 100 ∅ given. $t = 2mm$

die clearance = 2% per side

die clearance = $2 \times \frac{t}{100}$ = 0.04 per side

total die clearance = ~~0.08~~ 0.04+0.04 = 0.08

process tolerance = $\boxed{0.08}$

# Non Conventional Machining

① LASER BEAM MACHINING.

High intensity laser beam focused on metal. Melting and evaporation take place.

② EBM / AJM

Use of high speed abrasive particles carried by high pressure gas or liquid. Metal is removed due to erosion.

Air / $N_2$ used as gas.

$Al_2O_3$, SiC, $Ca(Mg)CO_3$, $Na_2CO_3$

Material of any hardness can be machined. Intricate machining can be done.

③ USM. ULTRASONIC MACHINING.

Tool vibrating longitudinally at 20-30 KHz is pressed onto the workpiece with a light force. An abrasive slurry is made to flow between them. Tool is of same shape as cavity required.

Machining hard and brittle materials that don't conduct electricity. Extremely fragile materials can be machined.

(1) EDM - ELECTRO DISCHARGE MACHINING

A spark is discharged on material causing erosion.

Tool - cathode        Workpiece - Anode

→ Bending

BA = bend allowance $= \frac{\pi\theta}{180^\circ}(R + Kt)$

degree

$K = 0.33 \quad R < 2t$

$K = 0.5 \quad R > 2t$

Bending force $\boxed{F_b = \frac{K \sigma_u L t^2}{w}}$

thk of job

length of job

width of die opening

| | | |
|---|---|---|
| $K = 1.33$ | $w > 8t$ | V-bend |
| $1.20$ | $w > 16t$ | V-bend |
| $2.66$ | $8t$ | U-bend |
| $2.4$ | $16t$ | U-bend |

→ Max possible reduction in wire drawing

$= 2.7183 = \frac{A_o}{A_i} = e$

max possible reduction $= \boxed{\frac{e-1}{e}}$